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colour inside

Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – ELECTRIC EQUIPMENT FOR ROLLING STOCK –

Part 1: General service conditions and general rules

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60077-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition of IEC 60077-1, issued in 1999. It constitutes a technical revision.

This edition includes the following main technical changes with regard to the previous edition:

a) Descriptions regarding insulation coordination, environmental conditions and those of current return and protective bonding are deleted and replaced by references to IEC 62497-1, IEC 62498-1 and IEC 61991, except classes of air temperature, which are copied from Table 2 in IEC 62498-1:2010.
b) Classification of equipment type is introduced.
c) Temperature limits and temperature rise tests are reviewed.
d) Example of lifetime calculation: Annex C (informative) is introduced.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/2266/FDIS	9/2278/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60077 series, published under the general title *Railway applications – Electric equipment for rolling stock*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

Although this document specifies the general service conditions and general rules for electric equipment for railway rolling stock, further special details of for certain types of traction electric equipment may be given in other IEC standards. In particular, product standards give further details and the product standards to be part of the traction series are

IEC 60077: *Railway applications – Electric equipment for rolling stock*

IEC 60077 series consists of the following parts:

- Part 1 – General service conditions and general rules
- Part 2 – Electrotechnical components – General rules
- Part 3 – Electrotechnical components – Rules for DC circuit-breakers
- Part 4 – Electrotechnical components – Rules for AC circuit-breakers
- Part 5 – Electrotechnical components – Rules for HV fuses

Although all circuits of power or control electronic equipment connected to battery or contact line voltages, and all circuits comprising switchgear or controlgear are covered by this document, internal circuits of these may be subject to special requirements covered by relevant product standards.

For electric equipment for rolling stock which conforms to an appropriate international standard, including items of industrial equipment, this document, plus the relevant railway equipment product standard for electric equipment where appropriate, specifies only those additional requirements to ensure satisfactory operation on rolling stock.

RAILWAY APPLICATIONS – ELECTRIC EQUIPMENT FOR ROLLING STOCK –

Part 1: General service conditions and general rules

1 Scope ~~and object~~

This part of IEC 60077 specifies the general service conditions and requirements for all electric equipment installed in power circuits, auxiliary circuits, control and indicating circuits etc., on railway rolling stock.

NOTE Some of these rules ~~may~~ can, after agreement between the user and the manufacturer, be used for electrical equipment installed on ~~other~~ vehicles other than railway rolling stock, such as mine locomotives, trolley buses, etc.

The purpose of this document is to harmonize as far as practicable all rules and requirements of a general nature applicable to electric equipment for rolling stock. This is in order to obtain uniformity of requirements and tests throughout the corresponding range of equipment to avoid the need for testing to different standards.

All requirements relating to:

- the environmental stresses expected during the normal service conditions;
- the construction;
- the performance and the associated tests which can be considered as general;

have therefore been gathered in this document together with specific subjects of wide interest and application, for example temperature rise, dielectric properties, etc.

In the event of there being a difference in requirements between this document and a railway rolling stock relevant product standard, then the product standard requirements take precedence.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60050(151):1978, *International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices*~~

~~IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*~~

~~IEC 60050(811):1991, *International Electrotechnical Vocabulary (IEV) – Chapter 811: Electric traction*~~

~~IEC 60056:1987, *High-voltage alternating-current circuit-breakers*~~

IEC 60068-2-1~~:1990~~, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

IEC 60068-2-2~~:1974~~, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

~~IEC 60068-2-3:1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*~~

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-52~~:1996~~, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

~~IEC 60071-1:1993, *Insulation co-ordination – Part 1: Definitions, principles and rules*~~

IEC 60085~~:1984~~, *Electrical insulation – Thermal evaluation and~~ classification of electrical insulation~~ designation*

~~IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*~~

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

~~IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*~~

IEC 60505, *Evaluation and qualification of electrical insulation systems*

IEC 60529~~:1989~~, *Degrees of protection provided by enclosures (IP Code)*

~~IEC/TR 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*~~

~~IEC 60587:1984, *Test method for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions*~~

~~IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*~~

IEC 60721-3-5~~:1997~~, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations*

IEC 60850~~:1988~~, *Railway applications – Supply voltages of traction systems*

IEC 61133:~~1992~~ 2016, ~~*Electric traction*~~ *Railway applications – Rolling stock – Testing ~~methods for electric and thermal/electric~~ of rolling stock on completion of construction and before entry into service*

IEC 61373~~:1999~~, *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 61991, *Railway applications – Rolling stock – Protective provisions against electrical hazards*

IEC 61992-1, *Railway applications – Fixed installations – DC switchgear – Part 1: General*

IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62497-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-1:2010, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules

Applications ferroviaires – Equipements électriques du matériel roulant – Partie 1: Conditions générales de service et règles générales

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IEC 60077 series consists of the following parts:

- Part 1 – General service conditions and general rules
- Part 2 – Electrotechnical components – General rules
- Part 3 – Electrotechnical components – Rules for DC circuit-breakers
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RAILWAY APPLICATIONS – ELECTRIC EQUIPMENT FOR ROLLING STOCK –

Part 1: General service conditions and general rules

1 Scope

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NOTE Some of these rules can, after agreement between the user and the manufacturer, be used for electrical equipment installed on vehicles other than railway rolling stock, such as mine locomotives, trolley buses, etc.

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- the construction;
- the performance and the associated tests which can be considered as general;

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IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60505, *Evaluation and qualification of electrical insulation systems*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-5, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations*

IEC 60850, *Railway applications – Supply voltages of traction systems*

IEC 61133:2016, *Railway applications – Rolling stock – Testing of rolling stock on completion of construction and before entry into service*

IEC 61373, *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 61991, *Railway applications – Rolling stock – Protective provisions against electrical hazards*

IEC 61992-1, *Railway applications – Fixed installations – DC switchgear – Part 1: General*

IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62497-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-1:2010, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPLICATIONS FERROVIAIRES – ÉQUIPEMENTS ÉLECTRIQUES DU MATÉRIEL ROULANT –

Partie 1: Conditions générales de service et règles générales

AVANT-PROPOS

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La Norme internationale IEC 60077-1 a été établie par le comité d'études 9 de l'IEC: Matériels et systèmes électriques ferroviaires.

Cette deuxième édition annule et remplace la première édition de l'IEC 60077-1 publiée en 1999. Elle constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) Suppression et remplacement des descriptions concernant la coordination de l'isolement, les conditions d'environnement et celles du retour de courant et de la mise à la masse par des références à l'IEC 62497-1, l'IEC 62498-1 et l'IEC 61991, à l'exception des classes de température ambiante, qui sont tirées du Tableau 2 de l'IEC 62498-1:2010.

b) Introduction d'une classification de type d'équipement.

c) Révision des températures limites et des essais d'échauffement.

d) Introduction d'un exemple de calcul de durée de vie à l'Annexe C (informative).

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
9/2266/FDIS	9/2278/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60077, publiées sous le titre général *Applications ferroviaires – Équipements électriques du matériel roulant*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous «http://webstore.iec.ch» dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTRODUCTION

Bien que le présent document spécifie les conditions générales de service et les règles générales pour les équipements électriques du matériel roulant, d'autres détails propres à certains types d'équipements électriques peuvent être donnés dans d'autres normes IEC.

La série de normes IEC 60077 comprend les parties suivantes:

- Partie 1: Conditions générales de service et règles générales
- Partie 2: Composants électrotechniques – Règles générales
- Partie 3: Composants électrotechniques – Règles pour disjoncteurs à courant continu
- Partie 4: Composants électrotechniques – Règles pour disjoncteurs à courant monophasé
- Partie 5: Composants électrotechniques – Règles pour les fusibles à haute tension

Bien que l'ensemble des circuits des équipements électroniques de puissance ou de commande alimentés à partir des tensions de l'accumulateur ou de la ligne de contact soient couverts par le présent document, leurs circuits internes peuvent être assujettis aux exigences des normes de produit correspondantes.

Pour les équipements électriques du matériel roulant, y compris les éléments de matériel industriel, qui répondent à une norme internationale propre, le présent document et, le cas échéant, la norme de produit d'équipement électrique spécifient seulement les exigences complémentaires pour assurer un service satisfaisant sur le matériel roulant.

APPLICATIONS FERROVIAIRES – ÉQUIPEMENTS ÉLECTRIQUES DU MATÉRIEL ROULANT –

Partie 1: Conditions générales de service et règles générales

1 Domaine d'application

La présente partie de l'IEC 60077 spécifie les conditions générales de service et les exigences pour l'ensemble de l'équipement électrique installé dans les circuits de puissance, les circuits auxiliaires, les circuits de commande, les circuits de signalisation et de surveillance, etc., sur le matériel roulant ferroviaire.

NOTE Après accord entre utilisateur et fabricant, certaines règles peuvent être utilisées pour l'équipement électrique installé sur des véhicules autres que ceux du matériel roulant ferroviaire, tels que les locomotives de mine, trolleybus, etc.

Le présent document a pour objet d'harmoniser dans la mesure du possible l'ensemble des règles et des exigences de caractère général applicables aux équipements électriques du matériel roulant; cela de manière à uniformiser les exigences et les essais de la gamme complète des matériels correspondants et à éviter d'avoir à effectuer des essais suivant des normes différentes.

L'ensemble des exigences relatives

- aux contraintes dues à l'environnement dans les conditions normales d'utilisation;
- à la construction;
- aux performances et aux essais correspondants qui peuvent être considérés comme généraux;

ont donc été rassemblées dans le présent document avec les sujets d'intérêt et d'application d'ordre général comme les échauffements, les propriétés diélectriques, etc.

Dans l'éventualité où une différence existerait entre les exigences du présent document et une norme de produit pertinente, les exigences de la norme de produit prévaudraient.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-1, *Essais d'environnement – Partie 2-1: Essais – Essais A: froid*

IEC 60068-2-2, *Essais d'environnement – Partie 2-2: Essais – Essais B: chaleur sèche*

IEC 60068-2-30, *Essais d'environnement – Partie 2-30: Essais – Essai Db: Essai cyclique de chaleur humide (cycle de 12 h + 12 h)*

IEC 60068-2-52, *Essais d'environnement – Partie 2-52: Essais – Essai Kb: Brouillard salin, essai cyclique (solution de chlorure de sodium)*

IEC 60068-2-78, *Essais d'environnement – Partie 2-78: Essais – Essais Cab: Chaleur humide, essai continu*

IEC 60085, *Isolation électrique – Evaluation et désignation thermiques*

IEC 60216-1, *Matériaux isolants électriques – Propriétés d'endurance thermique – Partie 1: Méthodes de vieillissement et évaluation des résultats d'essai*

IEC 60505, *Evaluation et qualification des systèmes d'isolation électrique*

IEC 60529, *Degrés de protection procurés par les enveloppes (code IP)*

IEC 60721-3-5, *Classification des conditions d'environnement – Partie 3: Classification des groupements des agents d'environnement et de leurs sévérités – Section 5: Installations des véhicules terrestres*

IEC 60850, *Applications ferroviaires – Tensions d'alimentation des réseaux de traction*

IEC 61133:2016, *Applications ferroviaires – Matériel roulant – Essais sur matériel roulant après achèvement et avant mise en service*

IEC 61373, *Applications ferroviaires – Matériel roulant – Essais de chocs et vibrations*

IEC 61991, *Applications ferroviaires – Matériel roulant – Dispositions de protection contre les dangers électriques*

IEC 61992-1, *Applications ferroviaires – Installations fixes – Appareillage à courant continu – Partie 1: Généralités*

IEC 62236-3-2, *Applications ferroviaires – Compatibilité électromagnétique – Partie 3-2: Matériel roulant – Appareils*

IEC 62497-1, *Applications ferroviaires – Coordination de l'isolement – Partie 1: Exigences fondamentales – Distances d'isolement dans l'air et lignes de fuite pour tout matériel électrique et électronique*

IEC 62498-1:2010, *Applications ferroviaires – Conditions d'environnement pour le matériel – Partie 1: Equipement embarqué du matériel roulant*